Additional Information for General Permit Application for Whales and Dolphins (section 238)

Q6 – Persons carrying out actions under the permit (cont.)

4	Name: Prof. Doug Cato
	Qualifications and experience: BSc, PhD. The most experienced whale acoustics researcher in Australia with more than 30 years working on whale acoustics, working in DSTG and Univ. of Sydney. Work has included measurement of whale songs and ambient noise around Australia. Supervisor to Ms Jones and will be overseeing the research.

5	Name: A/Prof KC Wong
	Qualifications and experience: BE, PhD Over 30 years experience working on airframe design, instrumentation, control, system integration, applications, flight testing and project management. Will assist in coordinating the UAV surveys.

6	Name: Others
	Qualifications and experience: The project will include a number of trained volunteers. Although they will be carrying out various activities under the permit, they will always be under the supervision of people listed above.

Q7 – Application for NSW National Park scientific licence attached.

Additional Information for Supplementary Form A – Whales and Dolphins (Cetaceans)

Q4

A) Equipment and methods used to comply with the EPBC Act Regulations

Collecting visual data on cetaceans requires close approach for adequate photo-identification and high-resolution UAV-captured imagery. For both boat and UAV surveys the maximum approach will be 50 metres.

Proposed methods:

1. **Land-based theodolite surveys.** Teams of observers will track humpback whales from Point Perpendicular on the northern end of Jervis Bay. Observations will be made using bare eyes, reticule binoculars and a theodolite. Data (group size, composition, position, and behaviour) will be capture using VADAR software.
2. **Boat-based photo-identification.** Boat surveys will be used to obtain photographs of whales for individual identification (photo-ID). An important aspect of studying the significance of Jervis Bay to migrating females with new born calves is estimation of the duration of their stay in the Bay. Photo IDs will aid in this process with whales that are resighted during their time in the Bay. Although this will tend to underestimate the true duration, it is simple and effective. Photo IDs are also valuable in determining which individuals have visited Jervis Bay previously, the previous calving history of females and the movements in the migration in previous years by comparing with the existing east Australian humpback whale population catalogue.

   Fluke photography will follow the standard practice of many previous experiments with this population of whales. The whales will be followed at a distance of 50 to 100 m. Telephoto lenses allow photography to be done at these distances, minimising the disturbance of the whales. Whales generally move slowly, females with calves averaging 3.6 km/h during migration (Noad and Cato, 2007) and even slower when in enclosed bays. At such low speeds, noise from boats following the whales will be far less intrusive than at normal boat speeds. Some whales may have to be followed for several surfacings before fluking. Generally, if they have not fluked after about 45 mins they are very unlikely to and we will break from them to concentrate on other groups.

   The photography will be taken from a small boat, about 6 m long. In addition to the driver, the boat crew on the boat, will include the photographer, an observer and someone to record observations digitally. The driver will be someone with many years of experience operating boats around whales during experiments and very familiar with normal whale behaviour. The boat will break away from the whales if they show any sign of unusual behaviour or stress.

3. **Uncrewed aerial vehicle (UAV) surveys.** A small (<2 kg) multirotor UAV (DJI Phantom or similar) equipped with imaging sensors will be used to take photographs and video of humpback whales. The UAV will be at least 50 m above the whales. This height should have minimal disturbance as heights of 25 m (Fetterman et al., 2019) and 30 m (Fiori et al., 2019) have been demonstrated to have no observed impact on cetacean species.

B) Steps taken to minimise impacts

1. **Land-based theodolite surveys**. Purely observational from land – will have no impact.
2. **Boat-based photo-identification.** We aim to minimise any potential stress to the whales. We will be looking for any signs of stress (e.g. tail slapping, quick changes in movement) and immediately leave the distressed animal or group it's in if these signs are observed. Particular care will be taken for groups with calves. As soon as sufficient data has been collected we will leave the group.
3. **UAV surveys.** The UAV surveys will be carefully controlled and monitored. The UAV will be flown in accordance with the Civil Aviation Safety Authority (CASA) and; be flown during the day, within visual line of sight, and not flown within 30 m of people. No individual whale will be exposed to the UAV for more than 30 minutes.

C) Research objectives

1. Assess the significance of Jervis Bay to the east Australian humpback whale (*Megaptera novaeangliae*) population, specifically for females with calves, during their southern migration.
   Specifically:
   a. Investigate the distribution, behaviour and movement patterns of humpback whale groups in and passing Jervis Bay using dedicated land surveys
   b. Utilise photo-identification methods to determine the minimum residency time of humpback whale groups in Jervis Bay
   c. Apply species distribution modelling to explore habitat usage patterns of mother-calf groups in Jervis Bay
2. Explore the effectiveness of multi-sensor payloads for detecting humpback whales in coastal waters using UAV-captured imagery

Q5.

A) Research proposal

Background:

Humpback whales undertake extensive annual migrations between high-latitude summer feeding areas and low-latitude winter breeding and calving areas (Dawbin, 1966). During this migration, the longest known for any mammal (Rasmussen et al., 2007), distinct temporal and geographic separation of activities, namely breeding/calving, resting and feeding, occur (Smith et al., 2012; Owen et al., 2015). For the east Australian humpback whale population [IWC substock E(i)], the known breeding and calving grounds, from June to September, are the warm and sheltered waters of the Great Barrier Reef (Smith et al., 2012). From here females and their calves migrate south, resting in relatively shallow, calm waters or protected embayments (Erts and Rosenbaum 2003; Franklin et al., 2011). These waters provide protection from rough seas, predators and conspecifics (Smultea 1994), and the calm surface conditions also reduce energy consumption during swimming for young calves (Cartwright et al., 2012). Mother-calf groups have been well documented resting in Hervey Bay, QLD (Franklin et al., 2011) and Jervis Bay has

been proposed as a potential new resting ground resulting from increased sightings over the last decade (Bruce et al., 2014).
This humpback whale population, estimated to be about 30,000 individuals, has been increasing at approximately 10.9% per annum for decades (Noad et al., 2011). With this increase in population size, there has been a substantial increase in the numbers of female calf groups observed in Jervis Bay where sightings were previously infrequent or negligible (Bruce et al., 2014). This may indicate that Jervis Bay has become an important resting area for females with calves, who are migrating to the polar feeding grounds for the first time and need suitable habitat to nurse and protect their young (Darling 2001). However, we have limited information to assess the significance of Jervis Bay in this respect and there are no ongoing observational surveys. The proportion of mother-calf pairs entering Jervis Bay during the southern migration, and their behaviour and residency time in the area has yet to be investigated. Jervis Bay National Park has marine protected areas but also has significant recreational and naval activity which needs to be managed. Information about the humpback whale groups entering Jervis Bay and their behaviour and residency is needed for this purpose.

Expected research contribution:
This study will use both conventional boat and theodolite surveys and test the effectiveness of remote sensing survey methods to assist in understanding the habitat usage patterns of humpback whales within Jervis Bay. Conventional land and boat based surveys are effective; however, they are also resource intensive, costly, and are unable to detect submerged animals (Godwin et al., 2016). Unmanned aerial vehicles (UAVs), provide possible alternatives to these well-established methods for determining abundance and distribution of cetacean species.
UAVs have several advantages over traditional methods, particularly manned surveys in aircraft. These include reduced costs, reduced human risks, observing submerged animals missed from land or boat surveys, the potential for high resolution data with accurate GPS locations, and ability to survey inaccessible habitats (Hodgson et al., 2013). UAVs have been successful in identifying marine mammals with conventional cameras and optical bands (Hodgson et al., 2013, 2017). This study proposes to use multispectral sensors which have greater capability for discriminating submerged objects compared with conventional camera systems (Podobna et al., 2010).

Please see above for methods.

B) Researchers

- Alexandra Jones, School of Geosciences, University of Sydney
- Jeremy Randle, Australian Centre for Field Robotics, University of Sydney
- Scott Sheehan, Marine Mammal Research
- Doug Cato, School of Geosciences, University of Sydney
- KC Wong, School of Aerospace, Mechanical and Mechatronic Engineering, University of Sydney

C) Relationship of researchers to permit applicant, funding etc.

Alexandra Jones, Jeremy Randle and Scott Sheehan are joint permit applicants.

Doug Cato is one of Alexandra Jones' PhD supervisors and will oversee the land and boat surveys. KC Wong will assist Jeremy Randle in coordinating the UAV flight. Funding for this project is provided by the University of Sydney Training Centre for Cubesats, UAVs, and their Applications.

Q6 – Ethics approval attached.

Q13 – There are no proceedings against the proposed permit holders

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